peculiar for having very large coracoid and acromion processes, the latter being broad, compressed, and lanceolate; and the body of the scapula is small in comparison with these processes.

The upper arm-bone is subcylindrical and slightly curved, nearly as long as the ulna and radius, which are compressed and parallel, having only a linear suture between them.

He says the carpal bones were nearly all lost, and only one or two of the digital bones were obtained; but, in a letter written three or four days afterwards, he states that he is going to send me a photograph of the scapula and paddle restored as well as the materials will allow.

BIBLIOGRAPHICAL NOTICES.

Recherches anatomiques et physiologiques sur les Champignons. Par J. B. Carnoy. (Bulletin de la Société Royale de Botanique de Belgique, tome ix. p. 157.)

It would seem, from some remarks at the close of the paper of which the title is given above, that it is intended to form one of a series. Although nominally embracing Fungi in general, it relates only to the *Mucorineæ*, and for the most part to a single species, supposed to be new, and which is called *Mucor romanus**. The author's remarks upon the polymorphism of this *Mucor* (that is, the number of phases which it assumes at different periods) are curious, and, if confirmed, will be of considerable importance. The paper is of great length; and in what follows an attempt has been made to give a concise summary of the author's views of the polymorphism of the species, without entering into the minutiæ of its anatomical and physiological details.

It would, M. Carnoy says, be a great mistake to suppose that the life of the *Mucorineæ* is confined within the narrow circle of a mycelium and a mucorinean fructification. Under certain conditions the *Mucorineæ* assume all the characters of the *Mucedineæ*; or, in other words, they have two lives or phases, a *mucorinean* and a *mucedinous*. The *mucorinean* phase has also its primary and secondary forms, of which the primary one is the normal well-known form of *Mucor*. The secondary forms are very numerous, but may be divided into two great groups:—1, sporangial forms, in which the sporangia are abnormal but the spores of which reproduce the normal form of *Mucor*; 2, acrogenous forms, or those in which, instead of sporangia, macroconidia are produced.

These macroconidia are of rare occurrence, and often will not germinate; but in experiments made with the spores of *Mucor romanus* it was found that when sown upon the heads of fish which

* The plant was discovered in a dark cave at Rome.

had been cooked, they produced a delicate and weakly mycelium, the vitality of which not being sufficient to reproduce the primary form, the preservation of the species was provided for by the condensation of its protoplasm into a secondary formation; that is, the mycelium became covered with terminal and interstitial macroconidia. These macroconidia produced a mycelium identical with that from a spore; in short, they reproduced directly the fundamental form of the species, from which M. Carnoy concludes that spores and macroconidia are physiologically identical.

In its mucedinous phase (*vie mucedinéenne*) *Mucor romanus* becomes under many circumstances completely metamorphosed. It assumes an appearance altogether new, and so different from the first that it would be impossible to recognize it without following out its change of form. This species (*M. romanus*) is far from being as polymorphic as many others of the same genus; but nevertheless it presents five sorts of fructification, corresponding to as many different forms:—1, the ferment-form (*forme levure*); 2, the *Penicillium*-form (*forme penicillienne*); 3, the *Botrytis*-form; 4, the *Torula*-form; 5, the Ascomycetous (?) form.

I. *The Ferment-form.*—The spores of *Mucor romanus* and of the Mucors in general, when cultivated on dry or unsuitable soil, develope solid internal nodules. If placed upon the pulp of an orange, the nodules disappear and the spores germinate normally. When the spores do not germinate normally, the nodules become granular at the centre, and the spore usually bursts and discharges the nodules, which become enlarged, exhibit a central cavity, and begin to bud. The same phenomenon may be seen in *Mucor vulgaris*, *M. caninus*, and in *Rhizopus*; and the several products (*levures*) are not distinguishable; they are of the nature of the organisms called by Hallier *Cryptococcus*. Other forms, such as *Protococcus* and *Arthrococcus*, would certainly be obtained by cultivating the spores in different media. The nodules are morbid growths arising from the spore not being able, from want of nourishment, to develope itself normally; it therefore organizes its protoplasm in a manner appropriate to the medium in which it finds itself, and extracts from the protoplasm germs destined to produce an inferior form which requires less sustenance to develope itself.

The *Ferment-form* of *Mucor romanus* developes rapidly, and forms a thick crust of a rosy-grey colour. If the *Ferment* be sown on dry orange-peel, it produces *Penicillium glaucum*; and the author has observed the same result to arise from the cultivation of ferments derived from different Fungi. He alleges that he has sufficient data to state positively that all Fungi cultivated under certain conditions are transformed into *Penicillium glaucum*, and that this is the reason why the latter fungus is so universally present. The *Ferment* always produces the mycelium of a *Penicillium*, never of a *Mucor*; and the spores of *Penicillium* again produce *Ferment*. Thus there is a passage from *Mucor* to *Ferment*, from *Ferment* to *Penicillium*, and from *Penicillium* there is a return to *Ferment*; but there is no direct return from *Ferment* to *Mucor*.

II. *Penicillium-form.*—Under defective nourishment, the spores of *Mucor*, instead of producing the mycelium of *Mucor*, produce that of *Penicillium*. The author has observed this fact five times in *Rhizopus* and several times in *M. vulgaris*. The same result follows if the spores are too old, as was observed in *M. caninus*, *M. romanus*, and *M. vulgaris*. Moreover a normal mucorean mycelium may be transformed into a mucedinous mycelium, in which case the septa (which are few in *Mucor*) multiply until the filaments are quite septate, as in true mucedinous filaments; at the same time the protoplasm becomes oily, and exhibits very regular and numerous cavities. The formation of septa and the change in the protoplasm are the certain signs of the change of a mucorean into a mucedinous filament, whatever may be the nature of the mucedinous fructification which it may ultimately bear. In a species of *Mucor* the author has observed the fructification of *Penicillium* proceeding from the base of the cell which supports the sporangium; but the *Mucor*-mycelium may become metamorphosed in the same way before normal fructification, and yield only mucedinous fruit. When *Mucor*-spores are sown on the pulp of an orange, the mycelium sometimes penetrates the pulp and appears on the sides transformed into *Penicillium*. It is not an exception or an anomaly, but a general rule, that the *Mucorineæ* can pass into the form of *Penicillium*. The cause of this transformation is defect of nourishment. The Mucors require considerable quantities of nitrogenous matters, whilst certain *Mucedineæ*, especially *Penicillium*, can live on an exhausted soil. It is doubtful whether *Penicillium* can reproduce *Mucor* directly, although perhaps such reproduction may take place through the macroconidia.

III. *Botrytis-form.*—If *Mucor romanus* is cultivated on cats' dung, it forms a strong mycelium: but after the second day the mycelium becomes septate, and on the third day it becomes altogether mucedinous. The transformed filaments grow and form a dense fleshy mass, which may be cut with a knife like the flesh of the large fungi. The mass is ultimately of a deep golden-yellow colour. Under the microscope, it is seen to consist of interlaced filaments crowned with a bunch of spores. This new mucedinous fungus is like one found by the author in Belgium and at Rome upon excrement, especially of cats. Without regard to physiology, the two forms might be united. The yellow colour of the mass is attributable to the spores, which, although evidently mucedinous, have entirely the nature of the spores or macroconidia of *Mucor romanus*. These spores, if sown on an orange, germinate immediately and produce a vigorous *Mucor*-mycelium. The mycelium at the end of the second day produced the sporangiferous cells of *Mucor romanus*. The allied form above alluded to behaves in the same way, but does not produce *Mucor romanus*; it gives rise to quite a different *Mucor*, very near *Mucor romanus*. The author knows two other analogous forms of *Mucedineæ* which produce in germination a mucorean mycelium without any intermediate mucedinous form.

From the above data two important laws may be deduced:— 1, there are mucedinous spores which have the nature of primary mucorinean spores; 2, some mucedinous spores and forms which are identical anatomically and morphologically, have an entirely different physiological nature, since they produce primary mucorinean forms which are quite distinct. If the white tufts of mycelium which grow upon excrement, and which, if left alone, would form the yellow masses of *Botrytis*, are transferred into hollows scooped out of an orange, such tufts become transformed into a *Penicillium*-mycelium, upon which the fruit of *P. glaucum* may be observed. The *Penicillium*-spores from the transplanted tufts, or from the transformed mucorinean mycelium, produce the yellow masses of *Botrytis* when sown on cats' dung. They produce a *Penicillium*-mycelium, but the ramifications of the latter enlarge, and assume the form of white tufts identical with those which proceed from a sporangial spore or a *Botrytis*-spore. They become covered with *Botrytis*, the spores of which, sown on fruit, reproduce immediately the primary mucorean form. It is clear, therefore, that the appearance of the different mucedinous forms of *Mucor romanus* is caused by soil. The *Botrytis* is a rich form, requiring more nitrogenized matter than *Penicillium*, which is a lower form, growing in any place where life can be maintained.

IV. *Torula-form.*—Many of the filaments of the septate mycelium of *Mucor romanus*, when growing on animal dejections, break into cylindrical cellules of various sizes, rounded at each end. These are sometimes the cellules of the mycelium; but more commonly they are little spore-cellules growing at the summit of the filaments, seven or eight in a row. The filaments usually run horizontally, and the formation of them resembles that of the mycelial macroconidia of the Mucors or of the spores of a *Torula*. These cellules in germination reproduce a *Penicillium*-mycelium, which either reproduces the same cellules, or which grows normally and yields the fruit of *P. glaucum*. This *Torula*-form never appears on a true mucorinean mycelium; it must be transformed into a mucedinous mycelium. This is so in many other Mucors, especially *M. vulgaris* and *caninus* and in *Rhizopus*. This *Torula*-form is probably caused by vibrionic fermentation; at least vibrios seem always present with this form.

V. *Ascomycetous form.*—Multicellular, spherical, or slightly elongated yellow bodies appear on the mucedinous mycelium of *Mucor romanus*. They are large enough to be seen with the naked eye. They are always found upon that part of the large mycelium of the primary or *Botrytis*-spores which radiates from the white tufts and extends horizontally over the soil. They are only found on very nitrogenized matter or on dejections. The author has not been able to make them germinate. They certainly belong to *Mucor romanus*, because macroconidia occur on the same filaments, and these macroconidia reproduce the primary mucorean form. The author thinks these bodies may be the rudiments of some Ascomycetous or Hymenomycetous fungus. In upwards of fifty *Ascomycetes* which the

author has examined, all develope in their early stage multicellular masses like those of *Mucor romanus*.

The *Botrytis*-form of *Mucor romanus*, and two analogous forms which the author has succeeded in producing from two other Mucors, also have similar bodies or their equivalents. One of these produces a quantity of black sclerotium almost as big as ergot. Many other Mucedines are states of thecasporous fungi. May not the *Botrytis*-Mucors be in the same case?

Perhaps the yellow bodies may produce an Hymenomycete. Two sorts of *Coprinus* have been seen by the author to commence by enrolment and segmentation of a mycelium-thread.

M. Carnoy concludes that possibly these facts may lead to the uniting in one group of the *Mucedines*, the *Mucorineæ*, the *Ascomycetes*, and the *Hymenomycetes*. These four general forms, of which as many classes have been made, are, in the author's opinion, only phases of existence destined to be passed through by one and the same mycological species, in order to complete and bring to a close the entire cycle of its development.

General Outline of the Organization of the Animal Kingdom, and Manual of Comparative Anatomy. By Thomas Rymer Jones, F.R.S. &c. 4th edition. 8vo. London: Van Voorst, 1871.

The short time that has elapsed between the publication of the third and fourth editions of Professor Rymer Jones's 'Animal Kingdom' shows that its reputation is so well established and its usefulness so generally recognized that for us to express any opinion upon its merits would be almost a work of supererogation. With all its defects (and we must confess that the author's intense conservatism makes these more numerous than they would otherwise be), Professor Jones's volume is actually the only work in our language to which we can refer the student as to a storehouse of sound zoological and anatomical details systematically arranged; and if the author would only add to his other qualifications a rather clearer idea of morphological matters, it would really leave little to be desired.

In the present publication Professor Jones has carried a step further the reform in his classification which was inaugurated in his third edition, and has accepted the group *Cœlenterata* as a zoological subkingdom. Nevertheless, by some strange confusion, he has failed to get the benefit from this step which he might have done; indeed it is questionable whether, as regards the value of his teaching, he would not have done better to leave matters as they were. From his expressions at page 4, and from the general arrangement of his chapters, he appears to consider that the Cuvierian Radiata have been divided into the two groups of Protozoa and Cœlenterata, than which nothing can be more erroneous; and this error is carried out by the arrangement of the Helminthozoa (including Turbellaria) and Echinodermata under the subkingdom Cœlen-